

CLAIMS

We claim:

1. An apparatus for filtering a natural gas stream, the apparatus comprising:
 - a closed vessel having a length and an initially open interior;
 - a partition disposed within the vessel interior, the partition having a planar inner and planar outer side, respectively, dividing the vessel interior into a first stage and a second stage;
 - at least one opening in the partition;
 - an inlet port in fluid communication with the first stage;
 - an outlet port in fluid communication with the second stage;
 - at least one tubular filter element, the tubular filter element being disposed within the vessel to sealingly extend from within the first stage, the filter element having a locking end, a tubular length, and a handle end;
 - a mounting structure located on a selected planar side of the partition;
 - a rotational mounting means on the locking end of the at least one filter element which cooperates with the mounting structure of the vessel for rotationally locking the filter element with respect to the partition upon rotational movement of the filter element from the handle end.
2. The apparatus of claim 1, wherein each of the filter elements has a generally cylindrical locking end and wherein the mounting means on the locking end of the filter elements is a slot provided in the cylindrical locking end.
3. The apparatus of claim 2, wherein the mounting means on the locking end of the filter elements is a J-slot.
4. The apparatus of claim 1, wherein the generally cylindrical locking end of the filter elements joins the tubular length of the filter elements at a neck region of each filter element, the neck region forming a region of increased external diameter along the tubular length of the filter element, and wherein a seal means is located at the neck region for sealing against the partition when the filter

1 element is locked in position.

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3 5. The apparatus of claim 4, wherein the seal means is a chevron-shaped seal.

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5 6. The apparatus of claim 4, wherein the seal means is an O-ring seal.

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7 7. The apparatus of claim 3, wherein the mounting structure located on a selected side of the
8 partition is a post which is aligned with respect to a partition opening and wherein the J-slot receives
9 and engages the post as the filter element is rotated from the handle end.

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11 8. The apparatus of claim 7, wherein the post is supported between opposing side flanges, the
12 side flanges being arranged generally perpendicular to the selected planar face of the partition,
13 whereby the post extends in a plane generally parallel to the plane of the selected planar face of
14 the partition.

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16 9. The apparatus of claim 3, wherein the mounting structure located on a selected side of the
17 partition is a pair of spaced apart post elements which are aligned with respect to a partition opening
18 and wherein the J-slot receives and engages the post elements as the filter element is rotated from
19 the handle end.

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21 10. The apparatus of claim 9, wherein the post elements are supported between opposing side
22 flanges, the side flanges being arranged generally perpendicular to the selected planar face of the
23 partition, whereby the spaced apart post elements extend in a plane generally parallel to the plane
24 of the selected planar face of the partition.

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26 11. The apparatus of claim 1, wherein the filter elements each have a filter wall and a hollow
27 core.

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29 12. The apparatus of claim 11, wherein the input port, the vessel interior, the tubular filter
30 elements, and the output port together define a flow passage within the apparatus, whereby the gas

1 stream flows into the first stage through the input port and through the filter wall of the filter
2 element and out the hollow core, thereby separating impurities out of the gas stream, and whereby
3 the gas stream then flows out of the second stage through the outlet port.
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5 13. The apparatus according to claim 1, wherein each of the tubular filter elements consists of
6 multi-overlapped layers of non-woven fabric strips.
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8 14. A tubular filter element for filtering a natural gas stream passing through a filter vessel, the
9 filter element comprising:

10 a body having a locking end, a tubular length and a handle end;
11 the tubular length of the filter body comprising a filter wall having a plurality of overlapped
12 layers of non-woven fabric strips, the filter body also having a hollow core;
13 a rotational mounting means on the locking end of the filter element which cooperates with
14 a mating mounting structure provided within the filter vessel for rotationally locking the filter
15 element with respect to the mounting structure upon rotational movement of the filter element from
16 the handle end.
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18 15. The filter element of claim 14, wherein the locking end of the filter elements are generally
19 cylindrical locking ends and wherein the mounting means on the locking end of the filter elements
20 is a slot provided in the cylindrical locking end.
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22 16. The filter element of claim 15, wherein the mounting means on the locking end of the filter
23 elements is a J-slot.
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25 17. The filter element of claim 15, wherein the generally cylindrical locking end of the filter
26 elements join the tubular length of the filter elements at a neck region of each filter element, the
27 neck region forming a region of increased external diameter along the tubular length of the filter
28 element, and wherein a seal means is located at the neck region for sealing against the mounting
29 structure when the filter element is locked in position.
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1 18. The filter element of claim 17, wherein the seal means is a chevron-shaped seal.

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3 19. The filter element of claim 17, wherein the seal means is an O-ring seal.

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5 20. A method of filtering solids from a natural gas stream, the method comprising the steps of:
6 providing a filter vessel having a first stage and a second stage, the first stage being separated
7 from the second stage by a partition having at least one opening;

8 installing at least one replaceable filter element within the filter vessel, the filter element
9 being sealed within the opening in the partition, the filter element having a locking end, a tubular
10 length, and a handle end;

11 providing a mounting structure located on a selected planar side of the partition;

12 providing a rotational mounting means on the locking end of at least selected filter elements
13 which cooperates with the mounting structure of the vessel for rotationally locking the filter element
14 with respect to the mounting structure upon rotational movement of the filter element from the
15 handle end;

16 filtering solids from the gas stream in the first stage; and

17 passing the gas stream from the filter element to the second stage.

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19 21. The method of claim 20, wherein the filter elements are provided with generally cylindrical
20 locking ends and wherein the mounting means on the locking end of the filter elements is a slot
21 provided in the cylindrical locking end.

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23 22. The method of claim 21, wherein the mounting means on the locking end of the filter
24 elements is a J-slot.

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26 23. The method of claim 21, wherein the generally cylindrical locking end of the filter elements
27 join the tubular length of the filter elements at a neck region of each filter element, the neck region
28 forming a region of increased external diameter along the tubular length of the filter element, and
29 wherein a seal means is located at the neck region for sealing against the partition when the filter
30 element is locked in position.

1 24. The method of claim 23, wherein the seal means is a chevron-shaped seal.

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3 25. The method of claim 23, wherein the seal means is an O-ring seal.

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5 26. A method of maintaining a filter vessel having associated tubular filter elements, the filter
6 vessel having a first stage and a second stage, the first stage being separated from the second stage
7 by a partition having at least one opening through which the filter elements are sealingly disposed,
8 the method comprising the steps of:

9 opening the multi-stage vessel;
10 removing at least one filter element from the filter vessel;
11 replacing the filter element with a replacement filter element;
12 creating a fluid-tight seal between the replacement filter element and the opening;
13 closing the multi-stage vessel; and wherein
14 the filter element is provided with a locking end, a tubular length, and a handle end;
15 a mounting structure is located on a selected planar side of the partition;
16 a rotational mounting means is located on the locking end of at least selected filter elements
17 which cooperates with the mounting structure of the vessel for rotationally locking the filter element
18 with respect to the partition upon rotational movement of the filter element from the handle end.

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20 27. The method of claim 26, wherein the step of creating a fluid-tight seal between the
21 replacement element and the opening in the partition is achieved by using an O-ring seal positioned
22 on the locking end of the filter element.

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24 28. The method of claim 26, wherein the step of creating a fluid-tight seal between the
25 replacement element and the opening in the partition is achieved by using a chevron-shaped seal
26 positioned on the locking end of the filter element.

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28 29. The method of claim 26, wherein the step of providing tubular filter elements consists of
29 providing tubular filter elements having multi-overlapped layers of non-woven fabric strips.

1 30. An apparatus for filtering a natural gas stream, the apparatus comprising:
2 a closed vessel having a length and an initially open interior;
3 a partition disposed within the vessel interior, the partition having a planar inner and planar
4 outer side, respectively, dividing the vessel interior into a first stage and a second stage;
5 an inlet port in fluid communication with the first stage;
6 an outlet port in fluid communication with the second stage;
7 at least one opening in the partition sized to receive a locking end of a tubular filter element
8 for supporting the filter element within the vessel;
9 a mounting structure located on a selected planar side of the partition, the mounting structure
10 comprising at least one post supported by side flanges so that the post lies in a plane which extends
11 at least partly across the opening in the partition.

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13 31. The apparatus of claim 30, wherein the post is selectively positioned with respect to the
14 partition opening for matingly engaging a rotational mounting means provided on the locking end
15 of the filter element for rotationally locking the filter element with respect to the partition and
16 thereby supporting the filter element within the vessel interior.

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18 32. The apparatus of claim 30, wherein the post is supported between opposing side flanges,
19 the side flanges being arranged generally perpendicular to the selected planar face of the partition,
20 whereby the post extends in a plane generally parallel to the plane of the selected planar face of
21 the partition.

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23 33. The apparatus of claim 30, wherein the mounting structure located on a selected side of the
24 partition is a pair of spaced apart post elements which are aligned with respect to a partition opening.

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26 34. The apparatus of claim 33, wherein the post elements are supported between opposing side
27 flanges, the side flanges being arranged generally perpendicular to the selected planar face of the
28 partition, whereby the spaced apart post elements extend in a plane generally parallel to the plane
29 of the selected planar face of the partition.

1 35. The apparatus of claim 30, wherein a conventional filter element is retrofitted to be installed
2 within the apparatus, the conventional filter element carrying mounting means for engaging the
3 partition opening of the apparatus.
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5 36. The apparatus of claim 35, wherein the mounting means is an element attachment rod which
6 is carried by the conventional filter element.
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8 37. The apparatus of claim 36, wherein the element attachment rod has an engagement end
9 which engages the at least one post supported by the side flanges of the mounting structure of the
10 apparatus.
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